measurement SPECIALTIES™

MEAS LT

Level & Pressure Transducers

USER MANUAL

2nd EDITION, April 2014

MEAS LT Level & Pressure Transducer User Manual

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MEAS LT Level & Pressure Transducer User Manual

1.0 Product Description

General Characteristics

MEAS LT Level and Pressure Transducers use isolated diaphragm sensors that can be used in aggressive applications with hostile fluids and gases. These sensors utilize a silicon pressure cell that has been fitted into a stainless steel or titanium package with an integral, compliant stainless steel or titanium barrier diaphragm. This sensor assembly is housed in a rugged 316 stainless steel or titanium case which provides for a variety of level ranges from 2.3 ft (0.75 m) H_2O through 692 ft (210.9 m) H_2O and pressure inputs from 1 psi (7 kPa) through 900 psi. Our devices feature internal signal conditioning. Standard outputs are 4-20 mA and VDC.

All units containing active electronic components have surge and reverse polarity protection. For ease of use in the field, our transducers are permanently laser engraved with our logo and name, wiring information, part number (P/N), serial number (S/N), date of manufacture (DOM), range, excitation and output. L T transducers are offered in 1.0" (25 mm) diameters.

Care and Handling

Our transducers are designed for rugged use. However, they need protection from over pressure and sharp impact. Penetrate the surface slowly, vertically and only to the depth necessary when lowering a transducer into a liquid. Avoid dropping the unit from above the surface. Clean all transducers by rinsing them in a mild detergent. Direct probing of the diaphragm or attempts to remove protective screens will damage the sensor, voiding the warranty.

Calibration

Calibration reports unique for each transducer are optionally available for all MEAS LT transducers, and must be ordered at the time of order placement. Should you misplace your calibration sheet, you may contact the factory and request a duplicate. All MEAS LT Transducer calibrations are traceable to the National Institute of Standards and Technology (NIST).

Approvals

UL and FM certification for intrinsic safety options are optionally available for MEAS LT transducers. Their respective installation control drawings can be downloaded from our website. Most products are CE compliant to EN 61326-1:2006 and EN 61326-2-3:2006. CE compliant units are labeled accordingly.

Units ordered with intrinsic safety are designed for installation in a Class I, Division 1, Groups A, B, C, and D, Class II, Division 1, Groups E, F and G, Class III, Division 1 hazardous location when connected to appropriate apparatus such as those manufactured by R. G. Stahl, Inc., and others.

2.0 Product Accessories and Options

WARNING: POTENTIAL ELECTROSTATIC CHARGING HAZARD

In hazardous locations:

- **Avoid building up static charge on case of data protector and plastic accessories.**
- **Use damp rag to wipe data protector and plastic accessories to avoid static build up.**

Nose Caps and Pressure Connections

There are several different pressure connection options for the MEAS LT submersible level and pressure transducer product line.

- The LTA features a ported nose cap (Delrin) with #8-32UNC-2B threaded-hole where weight accessories can be attached.
- The LTB features a wide mouth non-fouling cage protecting a 2.75" PTFE flexible diaphragm.
- The LTR features a wide mouth non-fouling heavy-duty cage protecting a 2.75" PTFE flexible diaphragm.
- The LT1 features a ¼" – 18 female NPT pressure connection.
- The LT5 features a ¼" – 18 male NPT pressure connection.
- The LT7 features a ½" – 18 male NPT pressure connection.

WARNING: Caution must be exercised when inserting a screw into the nose cap as the maximum insertion length should not exceed 0.175".

810 SuperDry™ Vent Filter or 815 Aneroid Bellows

All submersible level transducers and pressure transducers with molded cable attachment require an optional protective barrier that guards against moisture buildup in the cable vent tube. The 810 SuperDry™ vent filter and the 815 Aneroid Bellows are guaranteed to operate maintenance free for one year. The 815 Aneroid Bellows can be used on submersibles with accuracies of ±0.25% FSO. These barriers ensure reliable operation and long life as they protect sensitive electronic components from mildew and prevent the formation of a liquid column in the vent tube. Any such liquid column directly affects the instantaneous calibration of the transducer. Transducers with accuracy better than ± 0.25% should only be protected with the 810 vent filter in order to maintain this accuracy.

Sacrificial Anodes

Our sacrificial anodes are made from a special zinc alloy formulated to guarantee continued effectiveness over long periods. Because the anodes are 95% galvanic, they will not corrode unless there is an electrolytic demand. The anode maintains a high driving potential throughout its 12 month life, is self-sloughing and always exposes new zinc for the best possible protection. For those applications where cable buoyancy is a problem, the sacrificial anode can be substituted for hanging weights.

Sacrificial Anodes provide cathodic protection against galvanic corrosion for our submersible pressure transducers. Galvanic corrosion occurs when dissimilar metals are placed in contact with an electrolyte. This condition causes a potential difference to exist between the two metals, causing electron flow between them. Corrosion of the less corrosion-resistant metal is increased and attack of the more resistant metal is decreased. The 820 Sacrificial Anode is clamped to the exterior of a one-inch bore submersible transducer. We also offer a 1" diameter pencil anode, the 825, that attaches to the MEAS LTA nose cap. Sacrificial anodes can only be installed on the LTA.

Absolute/Sealed Gage Transducer

The sealed gage option for submersible transducers eliminates the need for a vent filter. The standard output of a sealed gauge transducer is 4 mA at 14.70 psia. The output of the transducer will need to be adjusted to compensate for the altitude difference with a separate barometric unit, if necessary.

Polyurethane & ETFE Jacketed Cable

Most installations of our submersible level transducers connect our polyurethane or ETFE cable to a junction box. From this junction box (P/N 840), users typically run their own cable to the required instrumentation. Polyurethane-jacketed cable is used for most applications while ETFE material is recommended for aggressive environments.

Specifications for our standard polyurethane and ETFE jacketed cable are as follows:

Specifications	Standard Submersible Cable	Standard Non-Submersible Wire
Weight	0.05 lbs/ft (0.07 kg/m)	0.025 lbs/ft (0.035 kg/m)
Min. OD	0.28" (7.10 mm)	0.189" (4.8 mm)
Max OD	0.31" (7.87 mm)	0.19" (4.9 mm)
Conductors	4 - 22 AWG	22 AWG
Insulation Conductors Outer jacket	Polyurethane, ETFE or PVC	Color coded PVC
Shield	36 gauge spiral tinned copper wire foil shield with drain wire	Aluminum/polyester foil facing outward
Vent Tube	Polyethylene, .060" ID (1.52 mm)	Drain wire 7/32 tinned copper

Chemical resistance of polyurethane:
Potable Water, Wastewater, Borax, Butane, Animal Fat, Carbonic Acid, Citric Acid, Cod Liver Oil, Corn Oil, Glycerin, Glycol, Mineral Oils, Potassium Nitrate, Potassium Sulfate, Silicone Oils, Stoddard Solvent, Tannic Acid (10), Tartaric Acid, Turbine Oil.

Chemical resistance of ETFE:
Acetic Acid (Glacial), Acetic Anhydride, Acetone, Aluminum Chloride, Anti- Freeze, Bromine, Calcium Chloride, Calcium Hydroxide, Chlorine, Copper Chloride, Ferrous Chloride, Hydrochloric Acid, Ketones, Lacquer Thinners, Sulfuric Acid.

The vented cable termination end is specially prepared at the factory to eliminate the potential for moisture migration. W here the lead wires emerge from under the jacket, there's potting material and a shrink tube "boot", every effort should be made to leave this feature intact. Should the cable be longer than needed for the installation, it is recommended that the excess length be accommodated in a service loop and that the potted end of the cable **NOT** be shortened.

The cable attached to this instrument is specifically engineered for submersible applications. The polyurethane outer jacket provides long term reliability under most conditions. The cable should be handled carefully, however, as the jacket may be subject to cutting should it be "raked" over extremely sharp edges. To guard against water incursion should an inadvertent minor cut occur, we have incorporated an exclusive "water block" feature immediately beneath the jacket. The cable is fully shielded, with the shield connected to the metal housing at the transducer end and terminated in a drain wire at the termination or user end. The shield should always be terminated to a good earth ground, unless the transducer is installed in an area where galvanic corrosion is known to be a serious problem.

Lightning Protection

Lightning and surge protection for VDC and 4-20 mA output are available. This is achieved through the use of 2 protectors, one is integral to the transducer housing and one is provided for the outside line located at the surface and grounded to a DIN-Rail. Please remember this option must be factory installed at the time of order entry or as a factory upgrade. **This option cannot be installed in the field.** Contact customer service for further details.

Featuring quick response and low clamping voltages, these devices protect against fast rising voltage transients as well as severe current surges associated with lightning discharges up to 20,000 amperes. Following a surge, the protector automatically restores the line to normal operation and awaits the next surge without having to reset a breaker or replace a fuse. The power supply needs to be limited to 150 mA to avoid lock up of the gas tube after a suppression event. If a lock-up should occur, reset by disconnecting and reconnecting power to the circuit.

Transducers installed with this option have a two year warranty *against damage due to voltage surge*.

Please note: When using the lightning protection option on 4-20 mA products, users should take into account the additional series resistance of this option when selecting the loop power supply. This option will increase total loop resistance by 88 Ohms, so the supply voltage must be at least 12VDC when lightning protection is installed.

Electrical Outputs

We offer the industry standard 0-5 VDC and 4-20 mA outputs. In addition, we also offer a variety of other voltage output ranges.

Cable Hanger

We can supply an optional cable hanger (P/N 12-90-0931) to help end users secure the cable. The cable hanger can be positioned anywhere on the cable by pushing the ends together. Once positioned, the cable hanger expands and provides a snug grip on the cable.

When mounting the transducer in a well casing, the cable hanger can be secured to a hook on the well plate or an eye bolt may be attached to the side of the well casing. The cable hanger loop is then secured to the eye bolt by using any number of types of fasteners. A similar technique can be used when working in stilling wells for surface water level measurement. In this case, the loop-end of the cable hanger can be attached directly to a screw or bolt bored into the still well shelf.

Submersible Cable Splicing Kit

Our field-installable cable splice kit (P/N 830) allows you to splice polyurethane and ETFE submersible cable. It is most commonly used for well applications where the more expensive ETFE cable is required for suspension in corrosive media where the liquid level is fairly shallow, but the well is hundreds of feet in depth. It is also used in emergency situations where cable must be spliced together to get an application up and running.

3.0 Installation & Maintenance Tips

WARNING: POTENTIAL ELECTROSTATIC CHARGING HAZARD

In hazardous locations:

- **Avoid building up static charge on case of data protector and plastic accessories.**
- **Use damp rag to wipe data protector and plastic accessories to avoid static build up.**

General Installation Procedures

The following is important installation and preventive maintenance information. Our Customer Service or Applications Engineering Support staff can provide additional instruction.

Transducer Anchors:

Most users either suspend our submersible transducers in stilling wells or attach them to rigid conduit. This is done to prevent damage to the transducer from shock caused by water turbulence. It is not advisable to tie your transducer to a pump or to piping, as any problem with the transducer could require that the pump be pulled from the installation. This could prove to be *very expensive*. (Please refer to the Cable Anchoring Schemes drawing in **Appendix A**.)

Some applications use our optional bracket (P/N 49-06-00PC) to clamp the transducer to a fixed object (i.e., wall, ladder, step) or require the unit to be suspended without any protective still well or attachment device. In all installations, care should be taken to ensure no damage occurs to the cable.

Transducer Submersion:

Damage to submersible cable is one of the most frequent causes of transducer failure. Lower your transducer into the liquid slowly, making sure the cable does not drag over sharp edges and only to the depth necessary. Avoid dropping the unit from the surface.

SuperDry™ Vent Filter (Desiccant) or Aneroid Bellows Installation:

(For submersible transducers vented gage pressure format only)

Always install a desiccant vent filter or aneroid bellows immediately after transducer installation**.** Failure to use one or the other could result in premature failure of the transducer; which would not be covered by warranty. If you use a desiccant filter, you should establish a regular maintenance schedule. You should change your vent filter when it is 75% spent (pink color). Replacement filters are available at a nominal cost from the factory. Do not remove the old vent filter until a new one is available. The most common failure mode of our transducers is moisture and corrosion damage due to lack of use or maintenance of the vent filter. This will allow air into the desiccant filter and allows the transducer to properly vent with changes in barometric pressure.

To install/replace either the aneroid bellows or the vent filter, simply unplug the old unit from the vent tube and plug the 0.062" x 1" stainless steel connector tube (supplied with each filter or bellows) into the vent tube. (Installation and mounting instructions are supplied with each aneroid bellows and vent filter.) The diagram on page 16 shows typical vent filter and aneroid bellows hookups.

Cable Protection:

An inexpensive way to protect the cable from damage is to order the submersible pressure transducer with a ½" conduit attachment. If further protection is needed, connect an inexpensive flexible 5/8" garden hose to the ½" conduit fitting with an inexpensive female PVC ½" NPT x 3/4" NHT swivel fitting, available at your local hardware store. These options are not supplied by MEAS.

Bending of Cable:

Our polyurethane and ETFE jacketed cables are quite flexible. Care needs to be taken to ensure that when bending the cable to suit your installation you do not crimp the vent tube inside the cable. Consequently, do not bend the cable more than a radius of 1 inch.

Cable Compression:

Many users require a compression fitting to secure our ETFE and polyurethane jacketed cable as it enters a junction box. Care needs to be taken that you do not over-tighten the fitting so as to damage the cable. Compression fittings are not supplied by MEAS.

4-20 mA Wiring:

When connecting a 2-wire 4-20 mA transducer to a typical power supply and mA meter, verify that the meter has an input impedance of at least 10 Ohms. If you are unsure of the input impedance, then a 10 Ohm resistor may be placed in series with the meter and transducer. Connect the + (red) lead of the transducer to the + terminal of the power supply. If the 10 Ohm resistor is required, connect it to the - (black) lead of the transducer. Use a short length of 22 AWG or heavier wire to connect the + terminal of the meter to the resistor (if it is required) or the - (black) wire of the transducer. Connect the - terminal of the meter to the - terminal of the power supply with a length of 22AWG or heavier wire. Connect the drain wire from the transducer to a good earth ground. (See **Appendix A**, page **13** for wiring diagram.) Please refer to "**Maximum Cable Lengths and Minimum Supply Voltage**" in **Appendix C**, page **19** to verify minimum loop supply voltage requirements.

VDC Wiring:

Connect a 3 wire VDC output transducer to a typical power supply and the voltmeter, connect the - terminal of the power supply to the - input terminal of the meter with a length of 22 AWG or heavier wire. Connect the - excitation (black) lead of the transducer to the - input terminal of the meter. Connect the + input terminal of the meter to the signal lead (white) of the transducer. Connect the + terminal of the power supply to the + lead (red) of the transducer. Connect the drain wire to a good earth ground. (See **Appendix A**, **page 13**.)

Protective Cage Diaphragm Protector:

The MEAS LTB and LTR come standard with a field removable diaphragm protector (one-inch or 25 mm standoff). The protective cage diaphragm protector can be removed by loosening six (6) fasteners located on the bottom of the unit.

Position Sensitivity:

The transducer should be installed so that the diaphragm located behind the nose cap is oriented in a vertical position, otherwise the unit could exhibit an offset.

General Maintenance Tips for Submersible Transducers:

Desiccant Maintenance

WARNING: POTENTIAL ELECTROSTATIC CHARGING HAZARD

In hazardous locations:

- **Avoid building up static charge on case of data protector and plastic accessories.**
- **Use damp rag to wipe data protector and plastic accessories to avoid static build up.**

If you use a desiccant vent filter, you should establish a regular maintenance schedule. You should change your vent filter when it is 75% spent (pink color). Replacement filters are available at a nominal cost from the factory. Do not remove the old vent filter until a new one is available. Remember that Measurement Specialties' improved 810 SuperDry™ Vent Filter is designed to be effective for at least one year before requiring replacement. Low and no maintenance options are also available.

Clogged Nose Piece or Dirty Diaphragm:

Either of these conditions could result in erroneous readings from your transducer.

WARNING: NEVER attempt to clean your transducer's nose piece or diaphragm with any object. This could dent or scar the sensor diaphragm and cause permanent damage to the transducer.

Your transducer may be cleaned in accordance with the procedures listed in step 4, below.

Cleaning your transducer:

Materials required:

- Plastic bowls 8-12 inches (200-300 mm) in diameter and 4-6 inches (100 - 150 mm) deep
- Supply of clean, lint-free cleaning rags
- Rubber gloves
- Mild liquid dishwashing detergent such as Dawn®, noted for its grease dissolving/cleaning capability
- Enough clear, clean water to fill two of the basins
- One 32 ounce bottle of "The Works® Tub & Shower Cleaner" available commercially through Wal-Mart, K-Mart, Target and Ace Hardware stores. http://www.theworkscleans.com/index.html

Preparation:

- Prior to cleaning your pressure transducer, ensure that all procedures have been followed in the proper cleaning of the cable and transducer to remove any biologically and chemically hazardous materials.
- The vent filter (or bellows) must be properly attached. The cable should be coiled to ensure ease of handling and it must be protected against the possibility of accidental abrasion and/or penetration of the cable jacket by sharp objects.
- A lead length of 1 to 1 ½ feet (0.3 - 0.45 m) of cable from the transducer should be allowed to facilitate handling during cleaning.
- The protective covering (or similar protective device) that is shipped with each transducer should be attached to the transducer at all times. It should only be removed prior to installation or cleaning.

Your work surface needs to be clean and free of clutter and large enough to accommodate all materials required in addition to the transducer and cable. Rubber gloves should be worn when working with "The Works®" cleaner. MSDS available from the manufacturer. Fill one of the bowls with fresh water, one with a mild detergent mixed with water and the last with 16 ounces (0.45 kg) of a bath/bath tub type cleaner.

Cleaning:

Step 1: Immerse the unit in the bowl containing the mild detergent and stir for 20-30 seconds, stirring and gently rubbing the exterior casing of the transducer to remove stubborn and built-up dirt and grime. Remove and thoroughly rinse in the bowl containing the fresh water. Rinse and wipe dry.

Step 2: Holding the body of the transducer with one hand so that you are looking at the retaining screen protecting the sensor, carefully remove the sensor nose piece by simply unscrewing it from the transducer body. *Do not touch the sensor diaphragm with your finger or any other object. Also, do not attempt to dry the inside portion of the transducer, as you risk damaging the pressure sensor*.

Step 3: Place the transducer in the bowl containing "The Works®" solution, and gently stir and move the transducer back and forth to thoroughly clean out the sensor portion of the unit. Again, do not touch the sensor diaphragm with your finger or any other object in an attempt to clean it, as you risk damaging the pressure sensors. Do this for approximately 15- 20 seconds. Rinse in the bowl containing clean water and wipe dry the external casing only. Place the nose piece in the same solution for 15-20 seconds, working to thoroughly clean it out. Rinse and wipe dry.

Step 4: Holding the transducer in a vertical position so that you can see the face of the sensor, screw the protective nose piece back into place.

Cleaning the Lightning Protection Data Line Protector

WARNING: POTENTIAL ELECTROSTATIC CHARGING HAZARD

In hazardous locations:

- **Avoid building up static charge on case of external surge protector and plastic accessories.**
- **Use damp rag to wipe data protector and plastic accessories to avoid static build up.**

4.0 Warranty and Product Return Procedure

Product Eligibility:

Units purchased with one year standard warranty or extended two-year warranty:

Units that fall within either age group that do not meet the product's specifications and exhibits **no obvious physical damage to the housing, sensor, or cable (cuts),** will be replaced under warranty.

Merchandise Return Procedures

Contact the **Applications Support Group** or the **Customer Service Department** at Measurement Specialties, Inc, Hampton, VA, if your transducer is not operating properly. Our staff is available for troubleshooting at **(757) 766- 1500** or toll free at **1-800-745-8008** during normal working hours, Eastern Time. If your transducer or accessory needs to be returned to Measurement Specialties, obtain a *Returned Merchandise Authorization* (RMA) from the Customer Service Department prior to shipment. Be prepared to supply the following information when requesting the RMA:

- Part number
- Serial number
- Complete description of problems/symptoms
- **Bill To** and **Ship To** address
- Purchase order number (not required for warranty repairs)
- Customer contact and telephone number

The above information, including the RMA number, must be on the customer's shipping documents that accompany the equipment to be repaired. Measurement Specialties also requests that the outside of the shipping container be labeled with the RMA number to assist in tracking the repairs.

All equipment should be sent to the following address:

ATTN: MEAS LT TRANSDUCER REPAIR DEPARTMENT
(7-digit RMA number)
Measurement Specialties
1000 Lucas Way
Hampton, VA 23666

Prior to returning to Measurement Specialties, the transducer and cable must be cleaned per instructions provided on the cleaning certificate supplied when the transducer was delivered.

The certificate can also be found on Measurement Specialties website:

- www.meas-spec.com

The completed certificate must accompany the transducer when shipped to Measurement Specialties. If the transducer has been used in media other than potable water, Measurement Specialties customer service must be notified at the same time an RMA number is requested. Measurement Specialties reserves the right to reject any shipment deemed to be unsanitary or environmentally unsafe to handle. If these guidelines are not met, the package will be sent back unopened and at the customer's expense.

Please include the attached cable, vent filter or aneroid bellow with each returned vented gage submersible transducer.

Measurement Specialties will return warranty items prepaid via UPS GROUND. If the customer desires another method of return shipment, Measurement Specialties will prepay and add the shipping charges to the repair bill.

Incoming freight charges are the customer's responsibility. The customer is also responsible for shipping charges to and from Measurement Specialties for all equipment not under warranty.

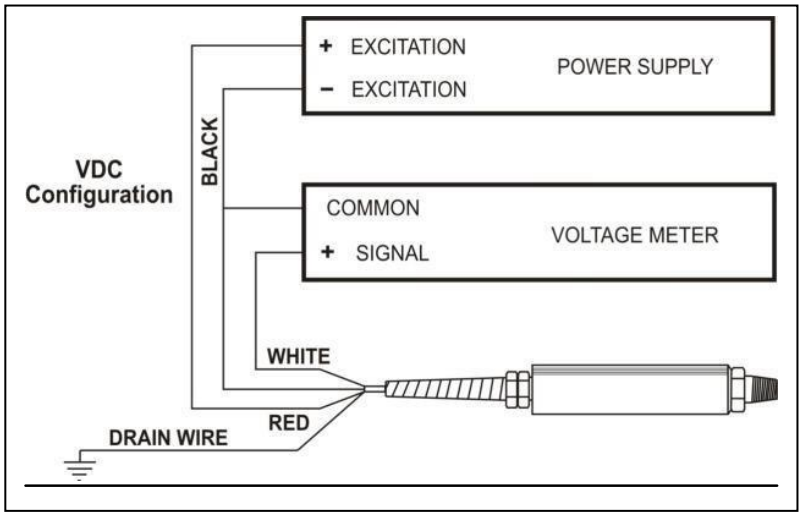
Once the return is received, it typically takes 5-10 working days for the technician to complete a fault determination.

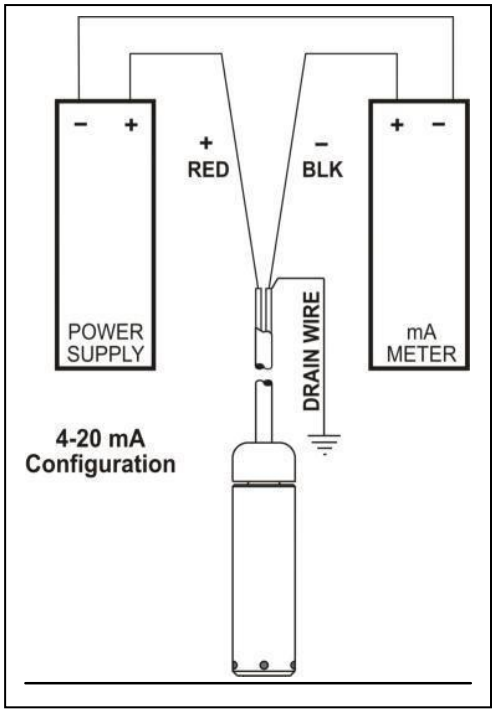
A **60% Purchase Order Cancelation fee** will be applied when the order is canceled within 24 hours of placement. The order cannot be canceled after 24 hours of placement.

NOTE: Expedite premiums and shipping charges are non-refundable.

Appendix A: Drawings and Diagrams

Wiring Diagrams for VDC and mA Outputs:





Notes:

These diagrams depict typical installations. Refer to your power supply and instrumentation manufacturer for the specifics of your application.

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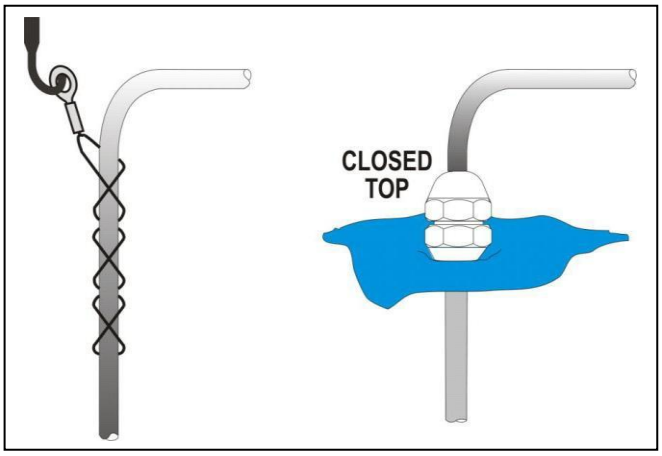
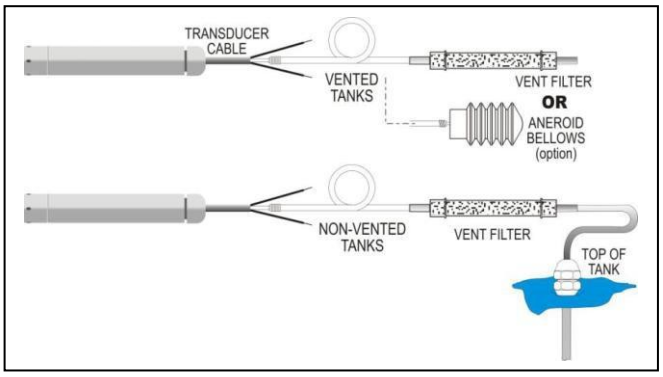
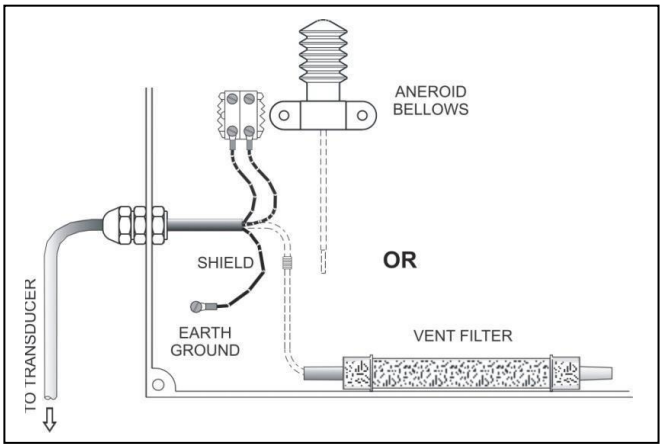
Cable Anchoring Schemes:



Reference Connection Schemes:



Submersible Cable Termination:



Appendix B: Frequently Asked Questions

1.	**Question:**	**What installation ideas do you have to help me get rid of electrical noise interfering with the signal?**
	Answer:	We strongly encourage you to secure our cable shield to a good earth ground and that you use a 4-20 mA signal output. Armed with these precautions and the fact that many of our transducers are CE approved for electromagnetic interference, you should have few problems. An ounce of prevention goes a long way. Either try to eliminate the source of noise or move the transducers as far away from it as possible.
2.	**Question:**	**The cable on the submersible transducer always seems to get cut and damaged. What am I doing wrong?**
	Answer:	This is the most common problem that our users encounter. Make sure that all of your colleagues and staff understand the importance of handling the cable with care. The cable should not be bent around rough or sharp edges. Always use a cable reel during transport. Where possible, suspend the unit in a perforated 2" (50 mm) PVC pipe and thread the cable through protective conduit to the nearest junction box.
3.	**Question:**	**I have an application where the transducer is frequently damaged by voltage spikes. What can be done to prevent this?**
	Answer:	At a minimum, make sure the cable shield is connected to an earth ground as near as possible to the transducer. We can provide a surge protection kit for both our submersible and non-submersible transducers. See page 4. These kits will handle typical spikes that might come in through the power lines as well as surges that travel through the ground due to nearby lightning strikes.
4.	**Question:**	**How much impact shock can your submersible transducers withstand?**
	Answer:	Our transducers are not shock tested and the lower pressure ranges can be damaged if dropped from several feet onto an unforgiving surface like concrete. We recommend that the protective shipping sleeve remain in place until the unit is installed.
5.	**Question:**	**What is the response time of your transducer?**
	Answer:	From initial power up, the transducer output will stabilize within a fraction of a second. The frequency response is rather low; probably less than 1 kHz, but it depends on the application, the media, plumbing, etc. Call our factory for application assistance if frequency response is critical in your application.

6.	**Question:**	**How do I attach your vent filter or aneroid bellows to my cable vent tube?**
	Answer:	The vent filter can be mounted anywhere convenient, preferably out of the weather. It can be mounted in any position and connects to the cable vent tube via the extension tube with metal connector tube provided. The aneroid bellows must be mounted in a way that its movement is not encumbered. It is provided with a mounting base.
7.	**Question:**	**What is the best way to mark my cable?**
	Answer:	Use white vinyl marking tape available from your local hardware or electronics stores. These same stores may also sell cable marking kits. Unfortunately we not provide this service.
8.	**Question:**	**Any ideas for preventing marine growth on your submersible transducers?**
	Answer:	You might want to try waterproof grease. Remove the threaded nose cap to facilitate applying the grease. **Take care not to damage the diaphragm when applying the grease and not to trap air bubbles against the sensing diaphragm**
9.	**Question:**	**How many measurements can you make before the diaphragm on the sensor fails?**
	Answer:	In normal operation – millions of cycles. We find that sensor failure is rarely due to diaphragm fatigue.
10.	**Question:**	**What is the turnaround time on repairs?**
	Answer:	Once we receive a unit into our facility it takes less than 10 working days to complete an evaluation.
11.	**Question:**	**What is the longest length of cable you have attached to a submersible transducer?**
	Answer:	Two thousand feet (610 meters).
12.	**Question:**	**Why do you use 316 SS housings and sensors for your standard transducers?**
	Answer:	It offers a good combination of corrosion resistance and reasonable cost. As

		an option, we do offer titanium for more aggressive environments.
13.	**Question:**	**What wire gauge should I limit myself to when connecting to your 22 AWG wire?**
	Answer:	Use 22 AWG or heavier.
14.	**Question:**	**Does it make any difference if I mount the transducer in a vertical or horizontal position?**
	Answer:	Yes. Our units will experience a certain amount of position sensitivity. You should mount it in a vertical position throughout the measurement cycle. If you lay the transducer down, the user must realize than an offset will occur.
15.	**Question:**	**What happens when you freeze your transducer in a column of water?**
	Answer:	We have frozen our transducers in a container of water in a home freezer with no resulting damage. However, depending on the level range of the unit, over pressure of the unit is possible. In harsh environments where debris is common and ice shifts, you might expect damage to both the transducer and cable.
16.	**Question:**	**Why would I choose a MEAS transducer versus a competitor?**
	Answer:	Reliable, long lasting products
		Lightning protection lifetime warranty
		Excellent pre & post sales/application support
		No hassle service

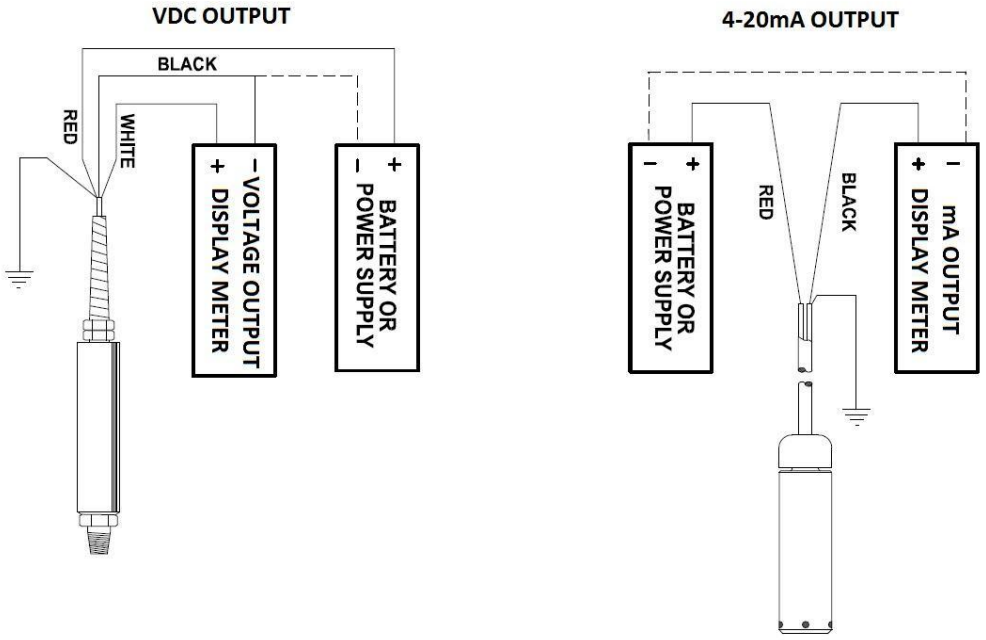
Appendix C: Transducer Field Checks

The following is a field check procedure for KPSI Level and Pressure Transducers. It is designed to provide the information you need to isolate problems that may occur when deploying a transducer. These checks will help eliminate the costly and time-consuming RMA process by determining in advance whether the transducer is operating properly.

When a problem is encountered with a transducer, it is helpful to test the transducer independently from the rest of the system, thereby establishing where to concentrate the troubleshooting effort. It is important to determine if the fault lies in the transducer or the instrument reading the transducer signal, i.e. digital panel meter, programmable logic controller, etc. If all of the following transducer tests deliver normal results, the problem may be found elsewhere in your system.

Below is a simple hookup diagram for the most common types of electrical output, a 0-5 VDC and a 4-20 mA transducers. The diagram above illustrates the attachment of the meter in series with the black (negative signal) wire of the transducer using a 12-28 VDC power supply for transducer excitation. Some suggested power supplies are:

- **(1) - 12 VDC automotive or lantern battery.**
- **(2) - 6 VDC lantern batteries connected in series (for a total of 12 VDC).**
- **(2) - 9 VDC transistor batteries connected in series (for a total of 18 VDC).**
- **A laboratory-style linear power supply capable of 12VDC minimum**



MEAS LT Level & Pressure Transducer User Manual

Batteries are suggested to power the transducer during testing to eliminate the possibility that line noise is passing through an improperly filtered, grounded, or damaged installation power supply.
The meter should be a digital type capable of reading at least 2 digits to the right of the decimal point.
A second instrument should be available to confirm the observations. A handheld Digital Multi-Meter (DMM) capable of reading 4-20 mA of current, or 0-20 VDC to a resolution of at least 0.01 decimal places.

Once your transducer is correctly configured per one of the diagrams**, orient the transducer in a vertical position with the pressure port down** and then read the zero output on your meter. For a 0-5 VDC output, the zero should be between 0 and 0.25 volts, and for a 4-20 mA output, between 3.75 and 4.25 mA. If the transducer is submersible, you may opt to test the unit's response in a container of room temperature water and observe its reaction to liquid pressure. It should return to the same zero point when removed. If the output is outside of these limits, note the results and continue to troubleshoot the transducer per the suggested measurements shown below.

Case check:

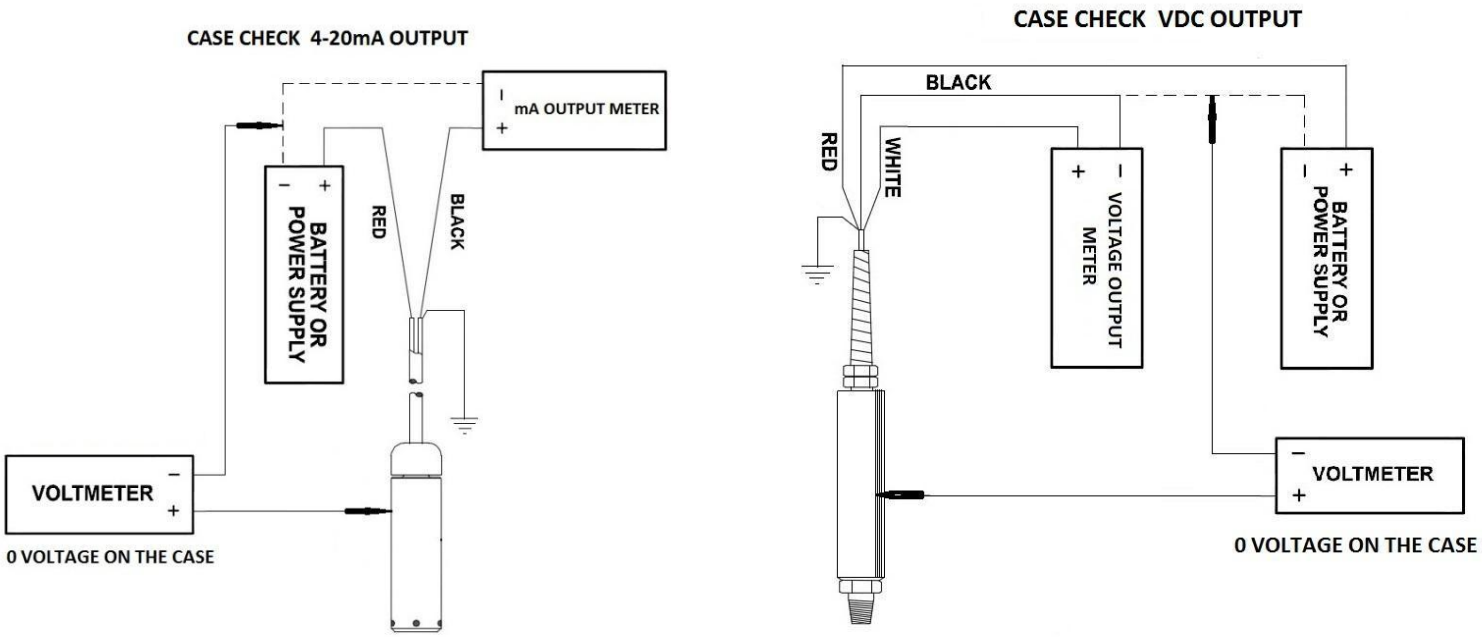
These checks (diagrams on the next page) are performed to detect internal shorts either in wiring that might have made contact with the structural components of the transducer, or from water intrusion that has made its way to the internal circuit board. In either case, there should be zero (0) voltage output on the case when the tests below are performed and checked with a Digital Multi-meter.

Further Measurements:

The following checks to the wiring should be made using a Digital Multi-Meter to insure that all connection wiring offer the listed resistance levels for proper operation.

0-5 VDC	Should read:	4-20 mA	Should read:
+Excitation (red) to Shield (drain)	> 2.5 Mohms	+Excitation (red) to Shield (drain)	> 2.5 Mohms
-Excitation (black) to Shield (drain)	> 2.5 Mohms	-Excitation (black) to Shield (drain)	> 2.5 Mohms
+Output (white) to Shield (drain)	> 2.5 Mohms	Shield (drain) to Housing	< 2 ohms
Shield (blue) to Housing	< 2 ohms		

All measurements outlined here should be recorded and sent to Measurement Specialties. We will review it with you, and determine if further evaluation is necessary. If so, an RMA (Return Material Authorization) number will be established, and you will be asked to send the results along with the transducer to assist in the RMA evaluation process. Measurement Specialties Customer Service Department can be reached at (800) 745-8008, or **WL.sales@meas-spec.com**.



Maximum Cable Lengths and Minimum Supply Voltage

The maximum length of cable to be used with our submersible transducers is largely dependent upon the type of electrical output of the transducer. For a 0-5 VDC output, a maximum cable length of 100 feet (30 m) is recommended. A voltage output is more susceptible to electrical interference than a 4-20 mA signal. A 4-20 mA signal can be transmitted much longer distances, depending upon such factors as temperature, wire size, length of the wire, power supply, and voltage requirements of any devices to be powered. At 25ºC the 22 AWG conducting copper wire used in our polyurethane jacketed cable has a resistance of 16.45ohms per 1000 feet (304 m).

Using Ohms Law (E=IR) where E=voltage, I=current and R =resistance, one finds that a 20 mA signal requires .329 volts to drive it along 1000 feet (304 m) of 22 AWG copper wire (E=16.45 x .020). This drop is seen on both the supply and return wire for a total loop voltage drop of 0.658 volts

To find out how much voltage is required to drive our MEAS LT submersible level transducer's 4-20 mA signal 10,000 feet, just add the minimum power requirement of the LT transducer (9 VDC) to the resistance offered by 10,000 feet (3048 m) of our polyurethane jacketed cable (10,000÷1000 x .658=6.58). The resulting power requirement is 15.58 VDC (9 + 6.58).

Connect the cable shield (drain wire) to a good earth ground. This will protect the transducer from

relatively minor transient voltages. The only exception to this rule is if high rates of electrolytic corrosion have been previously experienced with grounded submersible devices. In this case it may be better to leave the shield disconnected.

Please note: W hen using products with the lightning protection option on 4-20 mA products, users should take into account the additional series resistance of this option when selecting the loop power supply. This option will increase total loop resistance by 88 Ohms.

Symptom and Procedures:

1.	**Symptom:**	**Transducer fails to give output of any kind.**
	Procedure:	Isolate the problem to either the transducer or the power supply/readout. See the Quick Check Procedures (above) for this check. If it can be determined that the transducer is no longer operable, remove it from service for further analysis. If the transducer output falls within the limits described above, the fault lies somewhere else in your system.
2.	**Symptom:**	**Transducer has failed and has been removed for analysis.**
	Procedure:	Inspect the cable for physical damage. Cuts in the cable jacket can result in liquid incursion into the transducer housing, which can cause permanent damage. If operational, the cable can be repaired by using a splice kit (P/N 830) supplied by Measurement Specialties. Inspect the transducer housing. It should be intact and free of corrosion. If the outer surface of the transducer is pitted, this could be an indication of galvanic corrosion caused by stray ground currents. If this is the case, the transducer will probably require replacement. If the external case exhibits none of these characteristics, carefully unscrew the nosepiece and look into the pressure sensing end of the transducer. The concentric rings of the sensing diaphragm should be visible. If they are not, it could be that residue has accumulated on the diaphragm, preventing it from responding properly to pressure changes. The transducer can be cleaned by gently swishing the transducer back and forth in a bucket of warm, soapy water until the residue softens and washes off. (See **Cleaning Your Transducer**, pg 10) ***Under no circumstances should any object or tool be used to remove residue from the sensing diaphragm or else permanent damage will be done.*** If cleaning the diaphragm does not solve the problem, the transducer should be returned to the factory for repair or replacement.

3.	**Symptom:**	**Transducer develops a negative offset and gets worse over time (actual level exceeds specified level)**
	Procedure:	This may be a sign that moisture has entered the reference (vent) tube in the cable and is inside the transducer housing. This is usually the result of

		not maintaining the desiccant vent filter or of operating the transducer without a desiccant filter or aneroid bellows. If caught early enough, the transducer can be saved by coiling the cable and transducer in a pan and baking it in an oven at 50°C (122°F) for a minimum of 2 hours. *Be careful that the oven temperature does not exceed 50ºC (122°F)* or both the transducer and the cable can be damaged. **Alternatively**, suspend both the cable and transducer in a vertical position (with vent tube down), overnight to allow water to drain from the transducer and vent tube.
4.	**Symptom:**	**Transducer suddenly fails during or just after a nearby lightning event.**
	Procedure:	This failure is usually caused by overvoltage due to ground transients resulting from a direct or indirect lightning event. These transients can travel distances of a mile or more. The transducer may be returned to the factory for repair and optional retrofit of our ***lightning protection system.*** This system carries a lifetime warranty against transducer damage due to lightning.
5.	**Symptom:**	**Transducer response to pressure/level input changes becomes sluggish.**
	Procedure:	This is usually a sign that the sensing end of the transducer has become fouled with residue. The transducer must be removed from service and the sensing diaphragm cleaned as described in Item 2, (warm, soapy water). If fouling persists, the transducer may be replaced with a Series 705 or Series 750 (non- fouling) transducer, which is specifically designed for trouble-free operation in a high residue environment.
6.	**Symptom:**	**Output reading is within limits but "freezes" at one point.**
	Procedure:	In certain environments "crust" may form over the sensing diaphragm, preventing the sensor from identifying change in level. Removing the transducer from service and cleaning it (as described in Item 2) will generally solve the problem. To combat marine growth, you might try wrapping the transducer with copper wire similar to that found in wire scouring pads for cleaning dishes. Marine growth occurs on the copper and eventually erodes the copper and drops off or the copper is manually removed during routine maintenance. Alternatively, there are various companies that will impregnate/coat the 316 stainless steel with anti- fouling chemicals of coatings. Level transducers temporarily removed from the well or sump should not be stored dry, but should be stored in a bucket of fresh water in order to prevent “crust” formation.

7.	**Symptom:**	**Readings increase very slowly over time**
	Procedure:	Our cable is shipped coiled and consequently takes time to straighten when installed. Attaching a weight to the transducer (e.g., one of our sacrificial anodes) will help. To prevent cable stretch with lengths greater than 200 feet (60 m), secure the Kevlar fibers (just under the cable jacket) to your junction box or other secure object.
8.	**Symptom:**	**No electrical output from your transducer.**
	Procedure:	Check all electrical connections to ensure they are correct and secure. Double check your power supply or use a battery (as described previously) to ensure the transducer is getting power. If all checks OK, the problem could be a circuit board or the sensor in your transducer. The unit must be returned to the factory for evaluation. The most probable cause of this type of failure is damage to the submersible cable jacket allowing water to leak down the cable and into the transducer housing or lightning damage.
9.	**Symptom:**	**Formation of marine growth on a submersible transducer.**
	Procedure:	Certain transducer construction materials, for example, 316 stainless steel, attract marine life (snails) and algae. Clean the transducer diaphragm by soaking it in a bucket of warm water with a non-aggressive cleaning solution. You can also coat the transducer with marine grease. This may be the most effective and inexpensive way to protect your transducer.
10.	**Symptom:**	**Submersible transducer exhibits corrosion or pitting on body or diaphragm**
	Procedure:	Dissimilar metals (for example, your transducer housing and your pump housing) in an electrolytic environment (fluid in your well) can lead to *galvanic corrosion* of the metal that is nearer the anodic end of the galvanic series. Likewise, a voltage potential between the ground wire of the transducer and the ground of other equipment in the well can lead to *galvanic corrosion*. Installation of a P/N 820 or 825 sacrificial anode will help protect your transducer from *galvanic corrosion*. Our sacrificial anodes are made of a zinc alloy that, being nearer the anodic end of the galvanic series than the 316 stainless steel or titanium housing of the transducer, will corrode before the transducer.
11.	**Symptom:**	**The transducer is buried in dirt or silt and the readings seem to be**

		erroneous.
	Procedure:	Use of a piezometer nosepiece in this application would help. This optional nosepiece can be easily installed in the field and features a very fine screen to keep dirt from fouling the diaphragm, but allows the diaphragm to sense moisture levels.

12.	**Symptom:**	**Transducer has an offset error.**
	Procedure:	Our submersible transducers perform best when the sensing end is pointing in a downward manner. Keep in mind that you can experience offset error due to the position sensitivity or orientation change of the sensor. Offset errors are more prominent in low pressure applications with the sensing end of the transducer lying flat or pointing upward.
13.	**Symptom:**	**I am testing a MEAS LT 4-20mA sensor for use with our data logger. On page 13 of the MEAS LT Level and Pressure Transducers User Manual, I see the standard 4-20mA configuration. Does the recording channel of my data logger become the mA meter?**
	Procedure:	Most data loggers cannot measure current (mA) directly. W hen this is the case a load resistor must be used to convert the current (mA) output into an appropriate voltage. If the User's Manual for your particular instrument does not illustrate a preferred method for recording current (mA) data then you should attach your transducer signal wires to your data logger in the following manner: • Transducer red wire - Data Logger Excitation Terminal (The minimum excitation for a MEAS LT Transducer is 9VDC) • Transducer black wire – Data Logger signal input (+) terminal • Attach a Load resistor between the Data Logger signal input (+) terminal and the Data Logger signal input (-) terminal. • Attach a separate piece of wire between the Data Logger signal input (-) and analog ground. In this configuration you will turn your data logger into a milliamp meter. The size of your load resistor can be calculated in the following manner: • D/0.02 =R Where: o Data logger input range = D o Full scale output of transducer = 0.02 A (20 mA) o Load Resistor Value = R Pick an appropriate standard value

- 250 Ohms results in 1 to 5 VDC at 4 and 20 mADC
- 125 Ohms results in 0.5 to 2.5 VDC (500 to 2500 mVDC) at 4 and 20mA DC

At this point the discussion needs to address IR loss (voltage drop) in series circuits. Note that MEAS LT transducers need a minimum of 9 VDC to operate correctly. When the transducer is operating correctly it will output a current which, when driven through a resistor, will generate some amount of voltage drop.

If the resistor value is 250 Ohms then the voltage measured across that resistor will be 0.004 A * 250 Ohms = 1.000 VDC and 0.020 A * 250 Ohms = 5 VDC.

Notice that, if the available voltage from the data logger is12 VDC then 12 VDC - 5 VDC = 7 VDC which is less than the voltage required by the transducer to operate. If this scenario were to occur the transducer would actually stop functioning correctly when its output reached 12 mADC (50% of transducer full scale range). In this case the appropriate choice for a load resistor value is 125 Ohms.

14. **Symptom:** **I have a MEAS LT 4-20mA transducer rated for 7.5 PSIG attached to a pressure source that is outputting 7.5 PSIG. With 20VDC being supplied I am getting 19.94 mA. I can't find the upper range allowance for the sensor, but this seems low to me. Does this mA reading fall into the acceptable range for the transducer with the settings I've specified?**

Procedure: When evaluating a transducer it is sometimes convenient to make some broad generalizations in order to rapidly determine the condition of the unit. In general, transducers that output a 4-20 mA DC signal have a 16 mA DC span (4 - 20 = 16). If the transducers accuracy is reported as being some percentage of its full- scale range then the following table could be used in conjunction with the instructional notations to determine whether a more detailed analysis of data quality is required.

Accuracy Rating	Accuracy in mA DC
0.25% FS	±0.05 mA
0.10% FS	±0.016 mA

In order to approximately determine how many milliamps a transducer should output at a given depth:

1. Determine the depth (in feet) at which the transducer is sited.
2. Divide the depth value (from step 1) by the transducer full-scale range (in feet). - Record the value.
3. Multiply the value calculated in step 2 by 16 (the transducer span in milliamps).
4. Add 4 to the product of step 3. This is the approximate value in milliamps that should be output by the transducer at its current depth.

In order to approximately determine the depth of a transducer (in feet) using a given value of milliamps:

1. Divide the full-scale range of the transducer (in feet) by 16. Record this value.
2. Subtract 4 from the milliamp output of the transducer. Record this value.
3. Multiply the result of step 1 by the result of step 2. This is the approximate depth at which the transducer is sited.

If the resulting numbers are reasonably close to some verified value for current water depth, then the unit is functioning. In order to determine the quality of measurement, additional steps need to be performed.

Appendix D: Calibration Calculations

A calibration report option for each MEAS LT Level and Pressure Transducer is available at time of order. This sheet lists the actual values that were output by the transducer, when it was being manufactured, at several different pressures. In addition, two coefficients are provided that can be used to calculate the actual depth from any given mA output value. These coefficients are derived from a Least Squares Best Fit Straight Line (BFSL) calibration using the data listed on the datasheet. Our accuracy specification is referenced to the line described by the BFSL coefficients and so the transducer may not output exactly 4 mADC at zero pressure and 20 mADC at full-scale. As an example here is an example of data for a typical transducer.

Calibration Report

Test Date: 07/12/2012
Test Time: 10:31:20
Model No: LTA8ABBASA005PG025
Serial No: 1206087
Pressure Range: 0.00 to 5.00 PSIG
Excitation: 9-28 VDC
Output: 4-20 mA

Test Temps: Room = 25.0 DegC

PCU Serial No: 10833

Target Test Pressure	BFSL Rm Temp Outputs	Run #1 Rm Temp Outputs	Run #1 Error %FSO	Run #2 Rm Temp Outputs	Run #2 Error %FSO
0.00	3.9565	3.9768	0.1268	3.9784	0.1369
1.00	7.1435	7.1348	-0.0542	7.1361	-0.0463
2.00	10.3403	10.3205	-0.1241	10.3228	-0.1095
3.00	13.5371	13.5237	-0.0841	13.5244	-0.0798
4.00	16.7340	16.7370	0.0185	16.7390	0.0313
5.00	19.9310	19.9569	0.1623	19.9591	0.1764
4.00	16.7340	16.7365	0.0156	16.7393	0.0327
3.00	13.5372	13.5228	-0.0904	13.5255	-0.0730
2.00	10.3403	10.3217	-0.1163	10.3235	-0.1053
1.00	7.1435	7.1355	-0.0498	7.1364	-0.0443
0.00	3.9566	3.9786	0.1377	3.9788	0.1391

Maximum Static Error: 0.1764 %FSO

Maximum Non-Repeatability: -0.0174 %FSO

Electrical Termination:

RED: +SUPPLY
BLACK: -SUPPLY
BLUE: SHIELD

Slope1: 0.3128 PSIG/mA
Zero Offset 1: 0.0000 PSIG

Slope2: 3.1969 mA/PSIG
Zero Offset2: 3.9466 mA

Conversion Factor: 1.0000

Calculations:

Method 1: Calculate pressure in desired units, using sensor's output as independent variable.
PSIG = 0.3128 (mA - 3.9466) + 0.0000

Method 2: Calculate predicted sensor output in desired units using pressure as the independent variable.
mA = 3.1969 (PSIG - 0.0000) + 3.9466

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In this case, even though the offset or 0 PSIG output was 3.9565 mADC and the full-scale point was 19.9310 mADC, the unit actually performed better than its specified accuracy of ±0.25% of full-scale range (as indicated in the Error % FSO column) and is called out as maximum static error 0.1764% FSO.

The calculation for pressure is illustrated below:

PSIG = (Span*Output (in mA)) + Offset

To convert to feet of water: Feet H_2O = PSIG * 2.3073

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